

What is claimed is:

1. A three-dimensional structure verification supporting apparatus for supporting verification of a three dimensional structure by verifying properness of a three-dimensional image indicating the three dimensional structure of a substance, comprising:

a comparison image generating unit for generating a three-dimensional comparison image by adjusting image quality of the three-dimensional image with image quality of a reference image of the substance which is obtained experimentally; and

a degree-of-image coincidence computing unit for computing degree of image coincidence between the three-dimensional comparison image and the reference image of the substance.

2. The three-dimensional structure verification supporting apparatus as claimed in claim 1, wherein said comparison image generating unit generates the three-dimensional comparison image by blurring the three-dimensional image in accordance with image quality of the reference image of the substance.

3. The three-dimensional structure verification supporting apparatus as claimed in claim 1, wherein said comparison image generating unit generates the three-dimensional comparison image in accordance with the image quality of the reference image of the substance which is obtained experimentally by adjusting the image quality so that the degree of image coincidence between a three-dimensional image of a reference substance, of which a structure is known, and the reference image of the reference substance obtained by experimental structural analysis becomes the greatest.

4. The three-dimensional structure verification supporting apparatus as claimed in claim 1, wherein the three-dimensional image is a three-dimensional simulated image simulated by modeling in order to indicate three dimensional structure of a substance.

5. The three-dimensional structure verification supporting apparatus as claimed in claim 4, further comprising

a simulated-image supply unit for supplying said comparison image generating unit with the plurality of three-dimensional simulated images indicating a plurality of structures which are to be formed by the substance, wherein

said comparison image generating unit generates the three-dimensional comparison image for each of the plurality of three-dimensional simulated images, and

said degree-of-image-coincidence computing unit computes the degree of image coincidence for each of the plurality of three-dimensional comparison images.

6. The three-dimensional structure verification supporting apparatus as claimed in claim 5, further comprising

a structure data base storing thereon data indicating the plurality of structures, which are to be formed by the substance, as images, wherein

said simulated-image supply unit acquires the three-dimensional simulated image using the data stored on said structure data base, and provides it to said comparison image generating unit.

7. The three-dimensional structure verification supporting apparatus as claimed in claim 5, further comprising a selection unit for selecting data for specifying a structure of a substance corresponding to the three-dimensional comparison image, of which

the degree of image coincidence is judged to be the greatest, from a plurality of data specifying the plurality of structures.

8. The three-dimensional structure verification supporting apparatus as claimed in claim 7, wherein

said comparison image generating unit generates the plurality of three-dimensional comparison images captured from a plurality of angles for each of the plurality of structures,

said degree-of-coincidence computing unit computes degree of image coincidence between each of the plurality of three-dimensional comparison images captured from a plurality of angles, and the reference image of the substance captured from the same angle as each of the plurality of three-dimensional comparison images, for each of the plurality of structures, and

said selection unit judges acceptability of the degree of image coincidence using the result of the statistical application of the plurality of degrees of image coincidence for a plurality of angles.

9. The three-dimensional structure verification supporting apparatus as claimed in claim 4, further comprising a three-dimensional reconstruction image generating unit for generating a three-dimensional reconstruction image, which is a reference image of the substance, by processing a plurality of gray-scale images acquired by a transmission electron microscope.

10. The three-dimensional structure verification supporting apparatus as claimed in claim 1, further comprising:

a three-dimensional reconstruction image generating unit for generating a three-dimensional reconstruction image by processing a plurality of gray-scale images acquired by a transmission electron microscope; and

a shading unit for generating a three-dimensionally shaded image, which is the three-dimensional image, by shading the three-dimensional reconstruction image, wherein

said comparison image generating unit generates the three-dimensional comparison image using the three-dimensionally shaded image; and

said degree-of-coincidence computing unit utilizes the gray-scale image acquired by a transmission electron microscope as a reference image of the substance.

11. The three-dimensional structure verification supporting apparatus as claimed in claim 10, wherein

said three-dimensional reconstruction image generating unit turns the three-dimensional reconstruction image to an angle at which one of the plurality of gray-scale images is captured, and

said degree-of-coincidence computing unit computes the degree of image coincidence between the three-dimensional comparison image and the one of the gray-scale images.

12. The three-dimensional structure verification supporting apparatus as claimed in claim 11, wherein

said comparison image generating unit generates the plurality of three-dimensional comparison images corresponding to the plurality of gray-scale images,

said degree-of-coincidence computing unit computes the plurality of degrees of image coincidence using the plurality of three-dimensional comparison images, and

the three-dimensional structure verification supporting apparatus further comprises an instruction unit for statistically processing the plurality of degrees of image coincidence and instructing said three-dimensional reconstruction image

generating unit to adjust reconstruction condition of the three-dimensional reconstruction image using the processing result.

13. The three-dimensional structure verification supporting apparatus as claimed in claims 9 or 10, further comprising a three-dimensional reconstruction image generating unit, comprising:

- a shape computing unit for computing shape data indicating an outline of the substance using the gray-scale images captured from a plurality of angles;

- a distributing unit for generating a gray-scale density-distribution by extending and distributing density indicated in the plurality of gray-scale images to the angles at which the gray-scale images are captured, respectively;

- a second integrating unit for generating three-dimensional gray-scale data by integrating the plurality of gray-scale density-distribution generated from the plurality of gray-scale images captured from the plurality of angles and indicating the substance by three-dimensional image data;

- a first integrating unit for integrating the three-dimensional gray-scale data generated by said second integrating unit and the shape data; and

- a data processing unit for generating the three-dimensional reconstruction image from the three-dimensional gray-scale data by extracting only the gray-scale data which exists in a circumference of a shape indicated by the shape data.

14. The three-dimensional structure verification supporting apparatus as claimed in claims 9 or 10, further comprising a three-dimensional reconstruction image generating unit, comprising:

a shape computing unit for computing shape data indicating the outline of the substance using the gray-scale images captured from a plurality of angles; and

an image data generating unit for generating the three-dimensional reconstruction image by distributing the gray-scale data of the gray-scale images around the outline.

15. The three-dimensional structure verification supporting apparatus as claimed in claim 1, further comprising:

a comparison position data acquiring unit for acquiring a plurality of comparison position data indicating positions of a plurality of parts of the substance in the three-dimensional image; and

a reference position data acquiring unit for acquiring a plurality of reference position data indicating positions of the plurality of parts in the reference image, wherein

said degree-of-image-coincidence computing unit computes the degree of image coincidence using the plurality of comparison position data and the plurality of reference position data.

16. The three-dimensional structure verification supporting apparatus as claimed in claim 15, further comprising

a scaling unit for scaling one of the plurality of comparison position data and the plurality of reference position data into a state where the three-dimensional image or the reference image is expanded or reduced, wherein

said degree-of-image-coincidence computing unit computes the degree of image coincidence using the one of the plurality of comparison position data and the plurality of reference position data scaled by said scaling unit, and the other one of the plurality of comparison position data and the plurality of reference position data.

17. The three-dimensional structure verification supporting apparatus as claimed in claim 15, further comprising

a rotation unit for rotating one of the plurality of reference position data and the plurality of comparison position data into a state where the three-dimensional image or the reference image is rotated, wherein

said degree-of-image-coincidence computing unit computes the degree of image coincidence using the one of the plurality of comparison position data and the plurality of reference position data rotated by said rotating unit, and the other one of the plurality of comparison position data and the plurality of reference position data.

18. The three-dimensional structure verification supporting apparatus as claimed in claim 15, wherein

a three-dimensional simulated image computed by modeling is utilized for indicating three dimensional structure of the substance as the three-dimensional image, and

a three-dimensional reconstruction image obtained by processing a plurality of gray-scale images acquired by a transmission electron microscope, or one of the gray-scale images, is utilized as a reference image of the substance.

19. The three-dimensional structure verification supporting apparatus as claimed in claim 18, further comprising

a shading unit for generating a three-dimensionally shaded image by shading the three-dimensional reconstruction image, wherein

said comparison image generating unit utilizes the three-dimensionally shaded image as the reference image.

20. The three-dimensional structure verification supporting apparatus as claimed in claim 18, further comprising

a simultaneous displaying unit for displaying the rotating three-dimensional reconstruction image, or for displaying the three-dimensional comparison image rotationally in accordance with the three-dimensional comparison image or the gray-scale image while displaying the plurality of gray-scale images captured from a plurality of angles sequentially in the order of angles, wherein

said reference position data acquiring unit acquires the reference position from a screen display of said parallel displaying unit.

21. A three-dimensional structure verification supporting method for supporting verification of a three-dimensional structure by verifying properness of a three-dimensional image indicating the three dimensional structure of a substance, comprising steps of:

generating a three-dimensional comparison image by adjusting image quality of the three-dimensional image with image quality of a reference image of the substance which is obtained experimentally; and

computing degree of image coincidence between the three-dimensional comparison image and the reference image of the substance.

22. The three-dimensional structure verification supporting method as claimed in claim 21 further comprising a step of generating the three-dimensional comparison image in accordance with the image quality of the reference image of the substance which is obtained experimentally by adjusting the image quality so that the degree-of-image coincidence between a three-dimensional image of a reference substance, of which the structure is known, and the



reference image of the reference substance obtained by experimental structural analysis becomes the greatest.

23. The three-dimensional structure verification supporting method as claimed in claim 21, wherein the three-dimensional image is a three-dimensional simulated image simulated to indicate a three dimensional structure of a substance.

24. The three-dimensional structure verification supporting method as claimed in claim 23, further comprising steps of:

generating the plurality of three-dimensional comparison images using the plurality of three-dimensional simulated images indicating a plurality of structures which are to be formed by the substance;

computing the degree of image coincidence for each of the plurality of three-dimensional comparison images; and

estimating the structure used as a basis of the three-dimensional comparison image, of which the degree of image coincidence is the greatest, to be a structure of the substance.

25. The three-dimensional structure verification supporting method as claimed in claim 23, wherein the reference image of the substance is a three-dimensional reconstruction image obtained by processing a plurality of gray-scale images acquired by a transmission electron microscope.

26. The three-dimensional structure verification supporting method as claimed in claim 21, further comprising steps of:

generating a three-dimensional reconstruction image by processing a plurality of gray-scale images acquired by a transmission electron microscope;

generating a three-dimensionally shaded image, which is the three-dimensional image, by shading the three-dimensional reconstruction image;

generating the three-dimensional comparison image using the three-dimensionally shaded image; and

computing a degree of image coincidence between the three-dimensional comparison image and the gray-scale image, which is a reference image of the substance.

27. The three-dimensional structure verification supporting method as claimed in claim 26, further comprising steps of:

generating the three-dimensional comparison image by turning the three-dimensional reconstruction image to an angle at which one of the plurality of gray-scale images is captured; and

computing the degree of image coincidence between the three-dimensional comparison image and the one of the gray-scale image.

28. The three-dimensional structure verification supporting method as claimed in claim 26, further comprising steps of:

computing the plurality of degrees of image coincidence by generating the plurality of three-dimensional comparison images corresponding to the plurality of gray-scale images;

statistically processing the plurality of degrees of image coincidence; and

adjusting reconstruction condition of the three-dimensional reconstruction image using the processing result.

29. The three-dimensional structure verification supporting method as claimed in claims 25 or 26, further comprising steps of:

simulating shape data indicating an outline of the substance using the plurality of gray-scale images captured by a transmission electron microscope from a plurality of angles;

generating a gray-scale density-distribution by extending and distributing density indicated in the plurality of gray-scale images to the angles at which the gray-scale images are captured, respectively;

generating three-dimensional gray-scale data by integrating the plurality of gray-scale density-distribution generated from the plurality of gray-scale images captured from the plurality of angles and by indicating the substance by three-dimensional image data; and

integrating the three-dimensional gray-scale data and the shape data, and generating the three-dimensional reconstruction image from the three-dimensional gray-scale data by extracting only the gray-scale data which exists in a circumference of an outline indicated by the shape data.

30. The three-dimensional structure verification supporting method as claimed in claims 25 or 26, further comprising steps of:

simulating shape data indicating the outline of the substance using the plurality of gray-scale images captured by a transmission electron microscope from a plurality of angles;

simulating shape data indicating the outline of the substance using the plurality of gray-scale images of the substance captured from a plurality of angles; and

generating the three-dimensional reconstruction image by distributing the gray-scale data of the gray-scale image of the

substance captured by the transmission electron microscope around the outline.

31. A program for supporting verification of a three dimensional structure by verifying properness of a three-dimensional image indicating a three dimensional structure of a substance, comprising:

a comparison image generating module for generating a three-dimensional comparison image by adjusting image quality of the three-dimensional image with image quality of a reference image of the substance which is obtained experimentally; and

a degree-of-image-coincidence computing module for computing a degree of image coincidence between the three-dimensional comparison image and the reference image of the substance acquired by experimental structural analysis.

32. The program as claimed in claim 31, further comprising a three-dimensional image supply module for supplying said comparison image generating module with the plurality of three-dimensional images indicating a plurality of structures which are to be formed by the substance, wherein

said degree-of-image-coincidence computing module computes the degree of image coincidence for each of the plurality of three-dimensional comparison images; and

the program further comprises a selection module for selecting data for specifying the structure of the substance to be used as a basis of the three-dimensional comparison image, of which the degree of image coincidence is the greatest, from a plurality of data specifying the plurality of structures.